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Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 10679 (1983): Photoelectric Spectrophotometer (Single Beam Type) [PGD 22: Educational Instruments and Equipment]

“ज्ञान से एक नये भारत का निर्माण”

Satyanaaranay Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartṛhari—Nītiśatakam

“Knowledge is such a treasure which cannot be stolen”



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Indian Standard
SPECIFICATION FOR
PHOTOELECTRIC SPECTROPHOTOMETER
(SINGLE BEAM TYPE)

UDC 681.785.423



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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard
SPECIFICATION FOR
PHOTOELECTRIC SPECTROPHOTOMETER
(SINGLE BEAM TYPE)

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Indian Standard

SPECIFICATION FOR
PHOTOELECTRIC SPECTROPHOTOMETER
(SINGLE BEAM TYPE)

O. F O R E W O R D

0.1 This Indian Standard was adopted by the Indian Standards Institution on 21 October 1983, after the draft finalized by the Optical and Mathematical Instruments Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 Photoelectric spectrophotometer is a laboratory instrument used for quantitative measurement of intensity of light in narrow bands of monochromatic radiation useful for analytical studies in the areas of analytical chemistry, biochemical and clinical analysis, metallurgy, soil, water and food analysis. The spectrophotometer enables study of transmission and absorption characteristics of specimens over a wide band of spectral range. This instrument may be single beam or double beam type.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the basic requirements of a single beam direct reading photoelectric spectrophotometer capable of measurement at least over the spectral range 350 to 900 nm for non-fluorescent materials and solutions.

2. TERMINOLOGY — For the purpose of this standard the following definitions shall apply.

*Rules for rounding off numerical values (*revised*).

2.1 Percentage Transmission — The ratio of intensity of the transmitted light to that of the incident light. In mathematical terms,

$$\text{Percentage transmission} = \frac{I}{I_0} \times 100$$

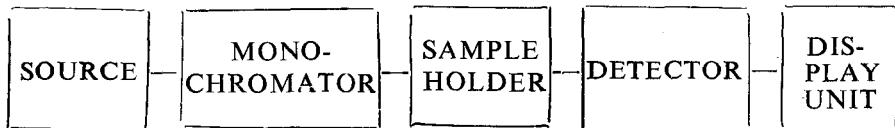
2.2 Optical Density — It is the logarithm to the base 10 of the ratio of the intensity of the incident light to that of the emergent light. In mathematical terms,

$$d = \log \frac{I_0}{I}$$

2.3 Monochromator — An instrument that provides homogeneous light of narrow band width.

3. GENERAL REQUIREMENTS

3.1 The spectrophotometer shall comprise of a radiation source, a monochromator, a sample holder, detector and a display unit.



3.2 Radiation Source

3.2.1 The source of radiation shall be stable. Its wattage shall be such that at any wavelength in the defined spectral region (350 to 900 nm), the display unit shall show readable observation when a neutral density filter of 1 percent transmission is introduced between the source and the photoelectric detector.

3.2.2 The source of radiation shall be provided with a continuously variable intensity control without changing colour temperature to enable taking measurements over a wide range of transmittance of samples. This shall also enable to set the display reading at 100 for initial setting of the spectrophotometer.

3.2.3 The spectrophotometer shall either have two or more ranges of measurement and a limited intensity control for setting the initial reading at 100 or shall have a wide range of intensity control.

3.2.4 The design of the radiation source unit shall be such that replacement of source shall be easy and convenient and shall not entail any major adjustments.

3.2.5 The source of radiation used shall meet the requirements of relevant Indian Standards, if available and applicable. Otherwise, it shall have a high stability and reliability factor. The source supplied with

the equipment shall be tested for a sufficient period to exclude the rigion of infant mortality.

3.3 Monochromator

3.3.1 The monochromator shall have a spectral range of 350 to 900 nm.

3.3.2 The means of setting the monochromator at any wavelength shall be convenient.

3.3.3 The wavelength at which the monochromator has been set shall be displayed on the calibration drum or linear scale digitally. The actual wavelength and the wavelength displayed on the drum or digitally shall not differ by more than ± 1 nm.

3.3.4 The band width of the monochromator shall be better than ± 10 nm.

3.3.5 The wavelength calibration if displayed on the drum or on linear scale shall be graduated at intervals of 5 nm. The numbering interval on the calibration scale shall not be more than 50 nm.

3.3.6 The exit slit of the monochromator shall be either of the following types :

- a) In case, the monochromator is of grating type, the slit may be of a fixed type to provide a band width of 15 nm or continuously variable type with a range of 0.01 nm to 2.0 nm.
- b) In the case of prismatic monochromator, the slit shall be variable type with a range of 0.01 nm to 2.0 nm. The slit shall be so coupled to the prism that for any wavelength the slit shall provide a band width of 15 nm.

3.3.7 The continuously adjustable slit, if supplied, shall be variable over the width range of 0.01 nm to 2.0 nm. The slit width setting shall be indicated on the slit width scale.

3.3.8 In the case of grating monochromator, the grating shall be a blazed type.

3.3.9 The dispersing component (prism or grating) shall be mounted suitably in a housing so as to avoid the accumulation of dust on it.

3.4 Sample Holder

3.4.1 The sample holder shall be robust and of suitable design so as to hold at least 2 samples at any time.

3.4.2 The sample holder shall be capable of holding glass cuvette of 10 to 25 nm path length.

3.4.3 The sample holder shall be of such design that it shall be possible to bring any of the samples held in it in the direct path of the light beam. There shall be only one position for the motion of the sample holder for bringing a sample in the path of the beam so that the beam falls centrally on the sample.

3.5 Detector

3.5.1 The detector shall be photoelectric type with a spectral range sensitivity over the entire range of the spectrophotometer.

3.5.2 In case more than one detector is provided to cover the entire spectral range, the design of the detector holder shall be such that by actuating a lever or knob, the desired detector shall come in the light path in the desired position. The change over of the detectors shall not require any subsequent adjustments.

3.5.3 The detector(s) shall have as nearly as possible, a flat response over the entire spectral range.

3.5.4 The detector unit may be provided with suitable amplifier circuitry to increase the range of operation, convenient display and adjustment of zero and 100 on the display unit.

3.5.5 Amplifier and other electronic circuitry, if provided with the detector unit, shall meet the requirements of relevant Indian Standard. The electronic components used shall have a high reliability factor.

3.6 Display Unit

3.6.1 The display unit shall display digitally or in analogue form the transmittance and optical density.

3.6.2 The transmittance range shall be from 0 to 100 percent and the optical density shall be from 0 to 1.5.

3.6.3 If displayed on a meter, the meter scale shall not be smaller than 100 nm. The entire range from 0 to 100 shall graduated at an interval of 2 and every tenth interval shall be numbered.

3.6.4 In the case of digital display, the electronic circuitry connected with the display unit shall meet the requirements of the relevant Indian Standard. The electronic components used shall have a high reliability factor.

3.6.5 In the case of analogue display, the meter shall meet the relevant requirements of IS : 1248-1968*.

3.7 The spectrophotometer shall be suitably designed to dissipate the heat energy of the radiation source. If a cooling fan is provided, it shall be mounted suitably so as not to transfer its vibrations to the source, monochromator, sample holder and the measuring unit.

3.8 The spectrophotometer shall be provided with a shutter mechanism so as to obviate exposure of detector to the strong light or the source when not in the measurement mode. A push button or switch shall be provided on the panel of the instrument to open the shutter when measurement is done.

3.9 All the controls on the panel shall be suitably marked to indicate their function and range. Switches shall be marked with ON-OFF positions.

3.10 Each spectrophotometer shall be supplied with the following :

- a) Operating manual, with circuit diagram,
- b) Six optical cuvettes,
- c) A spare source of radiation,
- d) Any special tools required for servicing of the equipment,
- e) Test specimen or instructions to check the accuracy of the equipment.

3.11 The design of the spectrophotometer shall be compact and rugged.

3.12 Each instrument shall be provided with a suitable cover to protect from dust when not in use.

3.13 The instrument may be provided with terminals to interface the output of the detector to the automatic recorder if so desired.

4. FUNCTIONAL REQUIREMENTS

4.1 The measurement accuracy of the spectrophotometer shall be better than 0.3 percent on the transmittance scale. This shall be checked by introducing neutral density filters in the path of light beam at different monochromator settings.

4.2 The accuracy of the monochromator setting shall be checked by standard spectral lamps.

*Direct acting electrical indicating instruments (*first revision*).

4.3 The accuracy of the variable width setting of the slit shall be checked by an accurate micron microscope.

4.4 The heat dissipation mechanism of the spectrophotometer shall be efficient. If the source of radiation is left on for half an hour, the rise in temperature in the radiation source housing shall not be more than 5°C.

5. MARKING

5.1 The instrument shall be marked legibly with the manufacturer's name or trade-mark and year of manufacture.

5.1.1 The instrument may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

6. PACKING

6.1 All the delicate and easily detachable parts, such as lamp, photo-electronic detector, and optical cuvettes, shall be suitably wrapped in tissue paper and separately packed in a small box to avoid damage during transit.

6.2 The instrument shall be wrapped in moisture and dust proof covering and packed securely for safe transit.

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